

### Trend Study 29R-3-03

Study site name: Elephant Gap Exclosure-Outside .

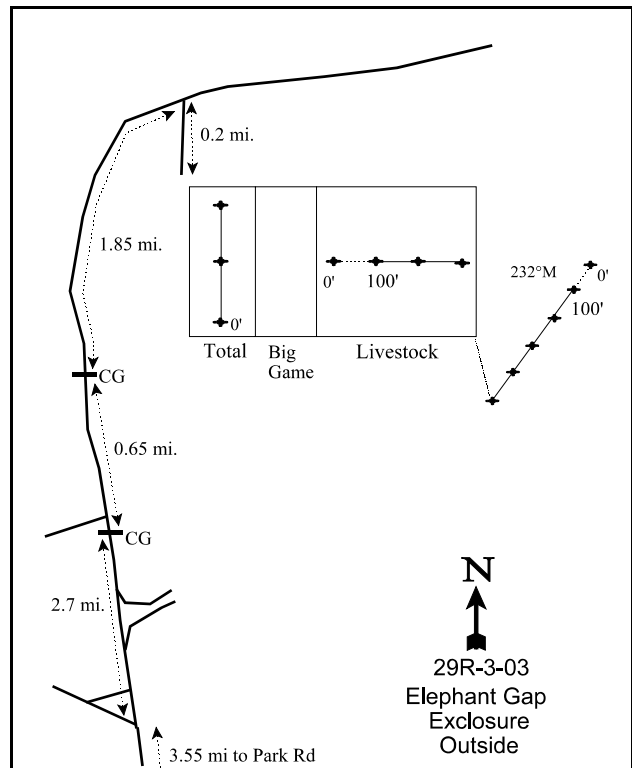
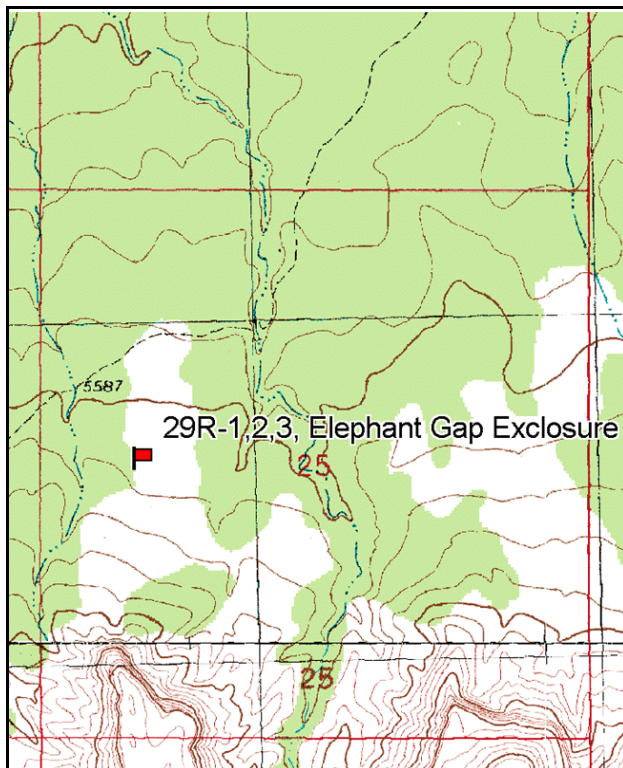
Vegetation type: Pinyon-Juniper .

Compass bearing: frequency baseline 232 degrees magnetic.

Frequency belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft).

### LOCATION DESCRIPTION

The starting point for this site is the entry to Coral Pink Sand Dunes State Park off of Hwy 89. From the entry of the park, travel south for 4.2 miles. Turn right and go 3.55 miles to a fork. Stay right and continue 2.7 miles to a cattleguard. Continue on main road for another 0.65 miles to another cattleguard. Drive another 1.85 miles to a faint road to the right (south). Drive on this road for 0.2 miles to the exclosure. From the southeast corner of the livestock exclosure, the 500 foot stake of the baseline is located 25 paces away at an azimuth of 186°M. The 0 foot stake is located 500 feet to the northeast at a bearing of 128°M. Browse tag #117 is attached to the 0 foot stake.



Map Name: The Barracks

Diagrammatic Sketch

Township 42S, Range 9W, Section 25

GPS: NAD 27, UTM 12S 4110447 N, 339832 E

## DISCUSSION

### Elephant Gap Exclosure Outside - Trend Study No. 29R-3

This study was established in 1998 outside of the exclosure complex at Elephant Gap. The Elephant Gap exclosure complex is located about 16 miles west-northwest of Kanab and about 9 miles northwest of the Coral Pink San Dunes State Park. This exclosure was built in the 1960's just north of Harris Point. The site has a slope of 7% with a northwest aspect. Elevation is approximately 5,600 feet. The area is composed of an open pinyon-juniper woodland with a mixed shrub understory. Deer use this area as winter range. Pellet group data estimated deer use at 95 days use/acre (235 ddu/ha) in 1998 and 46 days use/acre (114 ddu/ha) in 2003. Cattle use was estimated at only 2 days use/acre (5 cdu/ha) in 2003.

Soils are very deep, sand in texture, and strongly acidic (pH of 5.4). Effective rooting depth was estimated at 26 inches. Phosphorus and potassium are in limited amounts at just 3.5 ppm and 51.2 ppm respectively, which may be limiting to plant growth and development. Values below 10 ppm for phosphorus and 70 ppm for potassium are considered deficient. There is very little rock or pavement on the surface or within the profile. Cover of bare ground was higher outside than in either the total or livestock exclosures in both 1998 and 2003. Cryptogamic cover was estimated at 11% in 1998 and 7% in 2003. Soil temperature averaged nearly 70°F at a depth of 18 inches in 1998. High soil temperatures combined with the sandy nature of the soil result in rapid drying of the soil profile which effectively limits the establishment of shallow rooted plants. There is some soil pedestalling around shrubs, but erosion does not appear to be a significant problem due to the gentle terrain and high infiltration capacity of the soil.

The key browse species are basin big sagebrush, green ephedra, and antelope bitterbrush. The browse community outside of the exclosure provides much less cover compared to either the livestock or total exclosures. Basin big sagebrush provided 36% of the browse cover in 1998 and 26% in 2003. Total sagebrush cover was 5% in 1998 declining to 2% in 2003. Sagebrush density numbered 1,520 plants/acre in 1998, but decreased to only 540 plants/acre in 2003. The number of dead in the population nearly doubled in 2003, young recruitment slightly declined, and percent decadence increased from 45% to 74%. In 1998, utilization was light to moderate with a few plants displaying heavy use. Thirty percent of the plants sampled in 2003 displayed heavy use, and poor vigor increased from 28% to 44%. Over half of the decadent sagebrush in both surveys were classified as dying which will likely result in further losses for sagebrush. Sagebrush leaders averaged 2.5 inches of annual growth in 2003.

Ephedra density was estimated at 320 plants/acre in 1998, increasing to 500 in 2003. This population has received light to moderate use, maintained generally good vigor, and had moderate decadence. Mature plants are large, averaging 3 feet in height. Recruitment was high in 1998 as 44% of the population were classified as young plants. In 2003, the proportion of young decreased to 11%.

Bitterbrush is the most preferred species on the site, but it occurs in very low densities. Bitterbrush numbers only 20 plants/acre, and displayed heavy use and poor vigor in 2003. Bitterbrush leaders averaged nearly 6 inches of annual growth in 2003. Other shrubs occurring in limited numbers include sand sagebrush, rubber rabbitbrush, coin buckwheat, prickly pear, yucca, and gray horsebrush. Juniper and pinyon trees are found scattered throughout the area. Point-quarter data estimated 29 Utah juniper and 24 pinyon pine trees/acre in 1998. Average basal diameter was 9.8 inches for juniper and 5.5 inches for pinyon. Combined overhead canopy cover for juniper and pinyon was 10% in 2003.

The herbaceous understory is more abundant and diverse than the total exclosure and similar in composition and cover to the livestock exclosure. Grasses provided only 2% cover in 1998 and less than 1% in 2003. Sixweeks fescue was the most abundant grass in both surveys, although it declined significantly in nested frequency in 2003. Sand dropseed was the most abundant perennial species in 1998, but it also significantly decreased in 2003. The forb component is dominated by pale evening primrose, prairie evening primrose, and

milkvetch, as these species combined for 74% of the forb cover and 64% of the total herbaceous cover in 1998. Both of the primrose species significantly declined in 2003 with drought conditions, but milkvetch significantly increased in frequency and cover and now dominates the understory.

#### 1998 APPARENT TREND ASSESSMENT

Soil condition is poor with a considerable amount of bare ground (46%). There is some soil pedestalling evident around shrubs, but erosion is minimal due to the lack of slope combined with the high infiltration capacity of the sandy soil. The browse trend is very similar to the livestock enclosure. Basin big sagebrush appears to be in a state of decline with abundant dead plants, high decadence, and poor vigor on 62% of the decadent plants. Reproduction is fairly good with a biotic potential of 5% and 14% of the population being young. However, the current density of young plants is insufficient to replace the decadent/dying plants. The population could maintain itself with better recruitment in the future. Ephedra appears to be increasing with 44% of the population consisting of young plants. Utilization is light to moderate, vigor good, and percent decadence fairly low at 19%. The more preferred bitterbrush occurs in very limited numbers. Understandably, the one plant sampled was heavily hedged. The herbaceous understory is very similar to the livestock enclosure. Grasses provide only 2% cover with equal amounts of sand dropseed, blue grama, and six weeks fescue (an annual). Forbs combined to produce 12% cover with the most common species being pale evening primrose, prairie evening primrose, and milkvetch.

#### 2003 TREND ASSESSMENT

Trend for soil is slightly down. Bare ground increased to 54%, and vegetation, litter, and cryptogamic cover all declined in 2003. Erosion does not appear to be high due mostly to the gentle terrain and high infiltration rate of the sandy textured soil. Trend for browse is down. Basin big sagebrush is in very poor condition with a 64% decrease in population density, 3/4 of the remaining population being classified as decadent, and declining vigor and recruitment. The number of dead sagebrush sampled in 2003 was almost double that of 1998, and over half of the decadent age class was classified as dying. Ephedra increased in density due to the high proportion of young in the population in 1998. This species also showed increases in decadence in poor vigor in 2003, but neither is considered high. Bitterbrush remains very limited with only 1 plant being sampled on the transect. This plant was heavily utilized and was classified as having poor vigor. Trend for the herbaceous understory is down. Grasses were in low abundance in 1998, further decreasing in frequency and cover in 2003. Forbs had good production in 1998 and fair diversity. The evening primrose's both significantly decreased in 2003 while milkvetch significantly increased. With the drought in 2003, sum of nested frequency of perennial grasses and forbs declined by 35%. Nearly all of the herbaceous perennials showed significant declines in individual nested frequency values in 2003, and diversity was much lower as well.

#### TREND ASSESSMENT

soil - slightly down (2)

browse - down (1)

herbaceous understory - down (1)

HERBACEOUS TRENDS --

Management unit 29R, Study no: 3

Type	Species	Nested Frequency		Average Cover %	
		'98	'03	'98	'03
G	<i>Bouteloua gracilis</i>	10	7	.53	.02
G	<i>Bromus tectorum</i> (a)	<sub>b</sub> 20	<sub>a</sub> -	.10	.00
G	<i>Oryzopsis hymenoides</i>	1	3	.03	.00
G	<i>Sitanion hystrix</i>	1	-	.03	-
G	<i>Sporobolus cryptandrus</i>	<sub>b</sub> 40	<sub>a</sub> 7	.68	.01
G	<i>Vulpia octoflora</i> (a)	<sub>b</sub> 106	<sub>a</sub> 43	.68	.72
Total for Annual Grasses		126	43	0.79	0.72
Total for Perennial Grasses		52	17	1.27	0.04
Total for Grasses		178	60	2.06	0.76
F	<i>Ambrosia</i> spp.	-	-	.03	-
F	<i>Artemisia dracunculus</i>	<sub>b</sub> 14	<sub>a</sub> -	.53	-
F	<i>Astragalus</i> spp.	<sub>a</sub> 40	<sub>b</sub> 118	1.77	6.56
F	<i>Castilleja linariaefolia</i>	-	-	.01	-
F	<i>Comandra pallida</i>	<sub>b</sub> 40	<sub>a</sub> 20	.42	.14
F	<i>Cryptantha</i> spp.	<sub>b</sub> 28	<sub>a</sub> -	.25	-
F	<i>Descurainia pinnata</i> (a)	<sub>b</sub> 26	<sub>a</sub> -	.09	-
F	<i>Dithyrea wislizenii</i> (a)	<sub>b</sub> 28	<sub>a</sub> -	.89	-
F	<i>Draba</i> spp. (a)	3	-	.01	-
F	<i>Eriogonum cernuum</i> (a)	<sub>b</sub> 92	<sub>a</sub> -	.63	-
F	<i>Euphorbia</i> spp.	<sub>b</sub> 26	<sub>a</sub> -	.05	-
F	<i>Gilia</i> spp. (a)	15	17	.13	.31
F	<i>Lappula occidentalis</i> (a)	5	-	.01	-
F	<i>Oenothera albicaulis</i> (a)	<sub>b</sub> 40	<sub>a</sub> -	1.77	-
F	<i>Oenothera pallida</i>	<sub>b</sub> 144	<sub>a</sub> 73	5.56	1.60
F	<i>Sphaeralcea parvifolia</i>	7	-	.01	-
F	<i>Stephanomeria exigua</i> (a)	-	5	-	.16
Total for Annual Forbs		209	22	3.55	0.47
Total for Perennial Forbs		299	211	8.66	8.30
Total for Forbs		508	233	12.22	8.78

Values with different subscript letters are significantly different at alpha = 0.10

## BROWSE TRENDS --

Management unit 29R, Study no: 3

Type	Species	Strip Frequency		Average Cover %	
		'98	'03	'98	'03
B	<i>Artemisia filifolia</i>	0	0	.15	-
B	<i>Artemisia tridentata tridentata</i>	60	22	4.83	2.29
B	<i>Chrysothamnus nauseosus hololeucus</i>	1	3	.15	.03
B	<i>Ephedra viridis</i>	9	11	1.50	2.75
B	<i>Eriogonum nummularre</i>	0	2	.00	.03
B	<i>Juniperus osteosperma</i>	1	2	4.40	1.79
B	<i>Opuntia</i> spp.	7	6	.03	.36
B	<i>Pinus edulis</i>	0	0	.66	.63
B	<i>Purshia tridentata</i>	1	1	.15	.15
B	<i>Tetradymia canescens</i>	2	1	1.62	.66
Total for Browse		81	48	13.52	8.70

## CANOPY COVER, LINE INTERCEPT --

Management unit 29R, Study no: 3

Species	Percent Cover	
	'98	'03
<i>Artemisia tridentata tridentata</i>	-	1.43
<i>Ephedra viridis</i>	-	2.84
<i>Juniperus osteosperma</i>	4.00	9.00
<i>Pinus edulis</i>	1.00	1.20
<i>Tetradymia canescens</i>	-	.41

## KEY BROWSE ANNUAL LEADER GROWTH --

Management unit 29R, Study no: 3

Species	Average leader growth (in)
	'03
<i>Artemisia tridentata tridentata</i>	2.5
<i>Purshia tridentata</i>	5.7

POINT-QUARTER TREE DATA --  
Management unit 29R, Study no: 3

Species	Trees per Acre	
	'98	'03
Juniperus osteosperma	29	32
Pinus edulis	24	24

Average diameter (in)	
'98	'03
9.8	9.8
5.5	7.2

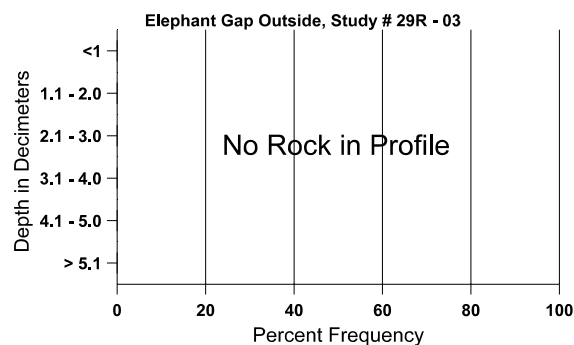
BASIC COVER --  
Management unit 29R, Study no: 3

Cover Type	Average Cover %	
	'98	'03
Vegetation	28.61	17.58
Rock	.01	.17
Pavement	.08	.02
Litter	38.06	33.89
Cryptogams	10.76	6.68
Bare Ground	46.34	54.31

SOIL ANALYSIS DATA --  
Management unit 29R, Study no: 3, Study Name: Elephant Gap Outside

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%OM	PPM P	PPM K	ds/m
25.9	69.0 (17.7)	5.4	90.7	2.7	6.6	1.3	3.5	51.2	0.1

## Stoniness Index



PELLET GROUP DATA --

Management unit 29R, Study no: 3

Type	Quadrat Frequency		Days use per acre (ha)	
	'98	'03	'98	'03
Rabbit	7	22	-	-
Deer	45	37	95 (235)	46 (114)
Cattle	1	1	-	2 (5)

BROWSE CHARACTERISTICS --

Management unit 29R, Study no: 3

		Age class distribution (plants per acre)					Utilization				
Y e a r	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% poor vigor	Average Height Crown (in)
<i>Artemisia filifolia</i>											
98	<b>0</b>	20	-	-	-	-	0	0	-	0	32/32
03	<b>0</b>	-	-	-	-	-	0	0	-	0	48/47
<i>Artemisia tridentata tridentata</i>											
98	<b>1520</b>	80	220	620	680	980	28	3	45	28	42/44
03	<b>540</b>	-	60	80	400	1720	19	30	74	44	32/30
<i>Cercocarpus montanus</i>											
98	<b>0</b>	-	-	-	-	-	0	0	-	0	24/25
03	<b>0</b>	-	-	-	-	-	0	0	-	0	-/-
<i>Chrysothamnus nauseosus hololeucus</i>											
98	<b>20</b>	-	-	-	20	-	0	0	100	0	45/61
03	<b>60</b>	-	-	40	20	-	33	0	33	0	41/56
<i>Ephedra viridis</i>											
98	<b>320</b>	-	140	120	60	80	25	0	19	6	41/83
03	<b>500</b>	-	80	260	160	-	28	0	32	12	38/53
<i>Eriogonum nummularre</i>											
98	<b>0</b>	20	-	-	-	-	0	0	-	0	36/49
03	<b>40</b>	-	-	40	-	80	50	0	-	0	21/29
<i>Juniperus osteosperma</i>											
98	<b>20</b>	-	-	20	-	-	0	0	-	0	-/-
03	<b>40</b>	-	-	40	-	-	0	0	-	0	-/-
<i>Opuntia spp.</i>											
98	<b>180</b>	-	20	140	20	-	0	0	11	11	4/12
03	<b>180</b>	-	-	160	20	20	0	0	11	0	4/11

		Age class distribution (plants per acre)					Utilization				
Y e a r	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% poor vigor	Average Height Crown (in)
Purshia tridentata											
98	20	-	-	20	-	-	0	100	0	0	11/26
03	20	-	-	-	20	-	0	100	100	100	-/-
Tetradymia canescens											
98	40	-	-	20	20	-	0	0	50	0	58/65
03	20	-	-	-	20	-	0	0	100	0	53/84
Yucca spp.											
98	0	-	-	-	-	-	0	0	-	0	29/28
03	0	-	-	-	-	-	0	0	-	0	27/31



## ELEPHANT GAP EXCLOSURE COMPARISON SUMMARY

Soil conditions are very similar between grazing effects. The soil is deep with a sandy texture and a slightly acidic to strongly acidic pH (5.4 to 6.2). Phosphorus and potassium appear to be limiting to plant growth and development on all sites, with some values well below 10 ppm for phosphorus and 70 ppm for potassium. Organic matter is low over all treatments. Percent bare ground is high on all sites, but highest outside of the exclosures at over 50% in 2003. Vegetation cover was highest in the livestock exclosure in 1998, with similar amounts outside and in the total exclosure. In 2003, the livestock and total exclosures had similar vegetation cover estimates, while outside was considerably less. Cryptogamic crusts were abundant outside and in the livestock exclosure at over 10% in 1998 and 7% in 2003. Soil temperatures are high on all sites averaging about 70°F. High soil temperatures combined with the high infiltration rates of the soil result in rapid soil drying in the surface horizons. This could be limiting to the establishment of shallow rooted plants. Soil erosion on all treatment effects appears to be minimal due to the levelness of the terrain, combined with the high infiltration capacity of the soil.

The key browse species for all grazing effects is basin big sagebrush and green ephedra. Antelope bitterbrush is the most preferred but it occurs in very low densities and is not abundant enough to be considered a key species at Elephant Gap. It's highest density occurs inside the total exclosure where big game and livestock do not have access. Basin big sagebrush density is similar between all 3 grazing effects ranging from about 1,200-1,500 plants/acre in 1998. Sagebrush density declined in all 3 treatments in 2003 with the largest decrease coming outside. The number of dead sagebrush increased in all 3 treatments in 2003, nearly doubling inside the total exclosure and outside. Dead sagebrush now outnumber live individuals on all 3 transects in 2003. Sagebrush recruitment was lowest in the livestock exclosure in 1998 at 7%, and highest in the total exclosure at 17%. Recruitment decreased in all 3 treatments in 2003, but remained fair in the total exclosure and outside at 11%. Percent decadence was average inside the total exclosure at 19% in 1998, but moderately high in the livestock exclosure and outside at 46% and 45% respectively. In 2003, decadence increased to 53% in the total exclosure, 74% outside, and 95% in the livestock exclosure. Poor vigor was high on all 3 transects in 2003 ranging from 44%-57%.

Several factors appear to be effecting sagebrush at Elephant Gap. Drought is likely the primary driving force behind deteriorating sagebrush health, but winter injury could also be a factor. Winter injury is presumably caused by freezing due to a lack of sufficient cold hardiness and/or winter drought or dessication (Nelson and Tiernan 1983). During mild winters, sagebrush can break dormancy during the middle of the winter and begin growth too early in the year. By doing so, sagebrush plants become susceptible to dessication and crown death if temperatures become very cold for any substantial length of time. Sagebrush injury also occurs because available soil moisture is minimal during winter months, especially within these deep sandy soils. Sagebrush conditions inside the livestock exclosure and outside were worse compared to the total exclosure with higher decadence rates and a larger number of dead plants in 2003. It appears that use could be an additive factor in addition to drought and winter injury in these 2 grazing effects.

In 1998, green ephedra density was highest inside the livestock exclosure, intermediate outside, and lowest in the total exclosure. Density slightly declined in the exclosure treatments, but increased outside in 2003. The proportion of young ephedra plants was high in all 3 treatments in 1998, declining somewhat in the livestock exclosure and outside in 2003. No young were sampled in the total exclosure in 2003. Ephedra has maintained relatively good vigor in both surveys in all treatments, and decadence has been low to moderate.

The herbaceous understory is limited on all grazing effects, particularly grasses. In 1998 and 2003, total herbaceous cover in order of decreasing abundance was as follows: outside, livestock exclosure, and total exclosure. Grass composition is similar between all sites, with the most common perennial species being blue grama, sand dropseed, bottlebrush squirreltail, Indian ricegrass, and needle-and-thread. Annual grasses, cheatgrass and sixweeks fescue, were also sampled on all 3 sites in 1998. With drought conditions in 2003,

perennial grass nested frequency declined in all grazing effects, and sixweeks fescue was only sampled outside the exclosures. Forb composition is similar between treatment effects with respect to the dominant species, but more species are found in the livestock exclosure and outside. Forb cover was 3 times higher in both the livestock exclosure and outside the exclosure in 1998 than in the total exclosure. The most abundant forbs in 1998 were pale evening primrose, prairie evening primrose, toadflax, and milkvetch. Both primrose's and toadflax decreased on all 3 sites in 2003, with milkvetch remaining stable in the livestock and total exclosures, and increasing outside.